A new tree-kangaroo (*Dendrolagus : Marsupialia)* from Irian Jaya, Indonesia, with notes on ethnography and the evolution of tree-kangaroos

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Summary. – *Dendrolagus mbaiso* n. sp. is a distinctive black and white macropodid which inhabits high elevation mossy forest along the southern and western slopes of the Maokop (Sudirman Range), Irian Jaya. It is of great cultural significance to the Moni people of the western Maokop. Among this language group, *Dendrolagus mbaiso* n. sp. is protected by specific socio-religious taboos which forbid its hunting and consumption as meat by the members of certain descent groups. Such traditional protection has aided its survival. Cladistic analysis reveals that *Dendrolagus mbaiso* n. sp. is a member of the 'derived group' as defined by Groves (1982) and Flannery and Szalay (1982). Its adaptation to a terrestrial lifestyle has resulted in considerable convergence with more plesiomorphic species of *Dendrolagus* as well as with other (terrestrial) macropodids.

Résumé. – *Dendrolagus mbaiso* n. sp. est un Macropodidé bien reconnaissable, blanc et noir, qui habite une forêt moussue d'altitude le long des pentes méridionales et occidentales du Maokop (Sudirman Range), Irian Jaya. Il a une grande signification culturelle pour les Moni du Maokop occidental. Dans ce groupe linguistique, *Dendrolagus mbaiso* n. sp. est protégé par des tabous socio-religieux spécifiques qui interdisent sa chasse et la consommation de sa viande par certains clans Moni. Cette protection traditionnelle a permis sa survie. L'analyse cladistique montre que *D. mbaiso* n. sp. est un membre du « groupe dérivé » qui a été défini par Groves (1982) et par Flannery and Szalay (1982). Son adaptation à une mode de vie terrestre est le résultat d'une convergence considérable avec les espèces de *Dendrolagus* les plus plésiomorphes et avec les autres Macropodidés terrestres.

INTRODUCTION

Tree-kangaroos (genus *Dendrolagus)* are highly distinctive macropodids which appear to be related to the rock-wallabies (genus *Petrogale)* (Baverstock *et al.* 1989). They are the only members of the family Macropodidae which habitually climb trees, and most species are primarily arboreal. Their morphology reflects this lifestyle, for all possess large and powerful forelimbs, and adaptations in the hindlimb which allow for extensive rotation of the foot (Flannery and Szalay 1982).

All are medium-sized (6.5-17 kilograms in weight), and are almost entirely restricted to tropical rainforests of New Guinea and north-eastern Australia (the exception, *D.*

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bennettianus, sometimes wanders into eucalypt woodland in north-eastern Australia). If *Dendrolagus mbaiso* n. sp. is included, there are ten species : eight in New Guinea and two in north-eastern Australia. Three species occur in sympatry in the Torricelli Mountains of northern New Guinea, but elsewhere in New Guinea one or two species co-occur in suitable habitat (Flannery and Seri 1990a, Flannery 1993). The two Australian species are allopatric.

The Australian species *Dendrolagus lumholtzi* and *D. bennettianus,* along with *D. inustus* of northern New Guinea, have been referred to a possibly paraphyletic plesiomorphic group (Groves 1982, Flannery and Szalay 1982). The other previously described species have been grouped in an advanced clade which possess a number of features that appear to be adaptations to an arboreal lifestyle (Groves 1982, Flannery and Szalay 1982, Flannery and Seri 1990a).

MATERIALS AND METHODS

This study is based primarily upon examination of the extensive holdings of *Dendrolagus* in the Australian Museum, Sydney. Material of all species is held there, and skeletal material of all except *D. spadix* is also represented. An appendix lists the material held. All measurements are in millimetres and weights are in grams. Body measurements were taken on freshly-dead or live animals in the field. The specimen listed as FV 1 in Table 5 was tagged and released. The holotype of *D. mbaiso* was lodged with the Bogor Museum upon completion of the study.

SYSTEMATICS

Family Macropodidae

Genus *Dendrolagus*

Dendrolagus mbaiso n. sp.

(Tables 1-3, Figures 1-2)

Holotype : AM M30751, adult female skin, skull, partial skeleton, partial body in spirit and tissue sample preserved in alcohol, collected at an elevation of 3,250-3,500 metres on the south slopes of Gunung Ki (04°05'S ; 137°06'E), Tembagapura area, Irian Jaya, Indonesia on 24 May 1994 by T. Flannery and A. Szalay.

Paratypes : AM M30719, adult male partial skin, skull and skeleton, collected at an elevation of 3,200 metres on 23 May 1994 ; other data as for holotype. AM M30754, adult female partial skin, skull and skeleton ; other data as for AM M30719. AM M30749, adult female skin, skull and partial skeleton, collected at an elevation of approximately 4,200 metres in the Milik area, Kwiyawagi region (04°S ; 138°E), Irian Jaya, Indonesia on 11 June 1994 by T. Flannery and A. Szalay.

Etymology : from *mbaiso* (pronunced em-by'-soh), meaning 'the forbidden animal' in the language of the Moni people of the eastern Sudirman Range, Irian Jaya. In tribute to the traditional conservation measures once widely practiced by the people of Melanesia. Such practices remain intact among the Moni largely as a result of the sensitive work of their missionary, John Cutts.

Diagnosis :

(1) Unique among macropodids in being boldly patterned in black and white ; venter from chin to cloaca white (occasionally with a black diamond on the chest),

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proximal portion of tail white or yellowish, tail tip often white, muzzle with white band around base, and white star on forehead (Figure 1).

(2) Tail shorter than any other species (Mean of tail to head-body ratio = 0.71, all others greater than 0.81 ; Table 4).

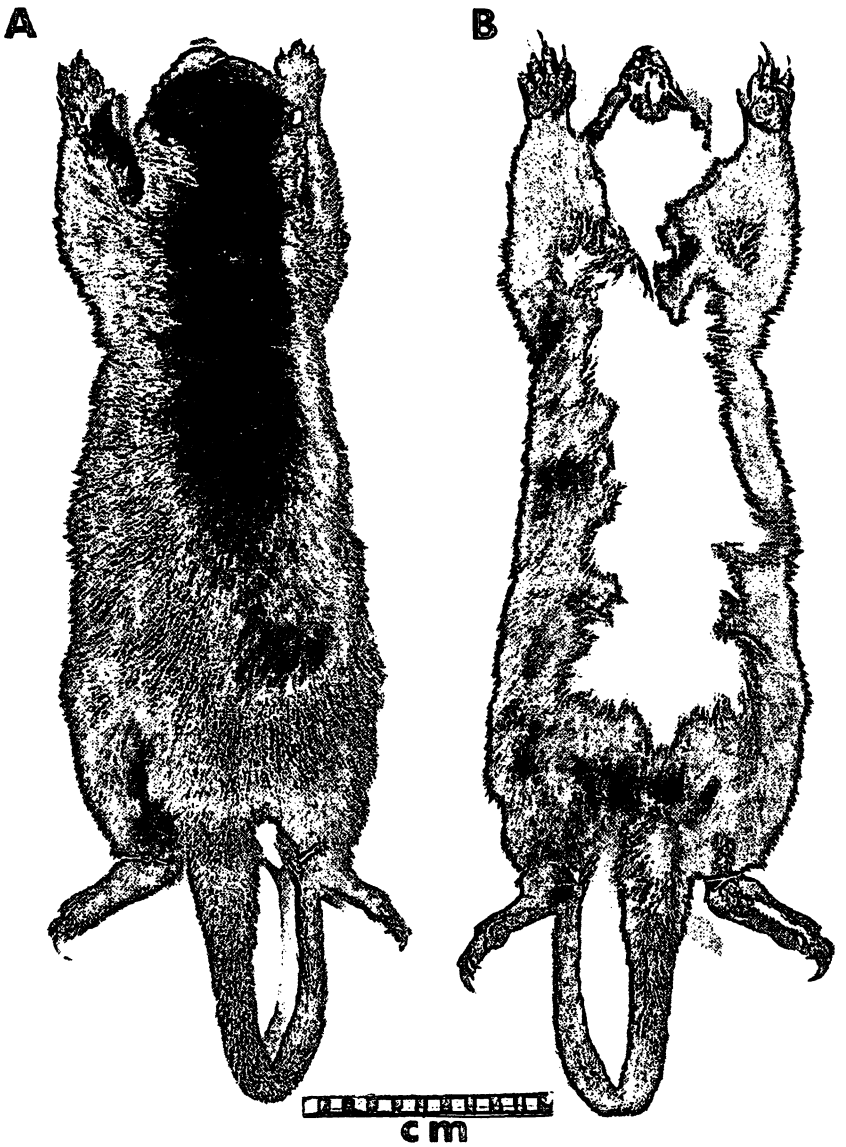

Figure 1. – Study skin in dorsal and ventral views of AM M 30751, holotype and AM M 30749, female paratype.

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(3) Rostrum of skull relatively narrower than in any other species ; dentary relatively gracile (Figure 2).

(4) Similar to *D. ursinus* in that tibia and fibula contact over 14.4-24.4 mm (in *bennettianus, lumholtzi* and *inustus* 33.3-46.0 mm ; in all others < 5.9 mm).

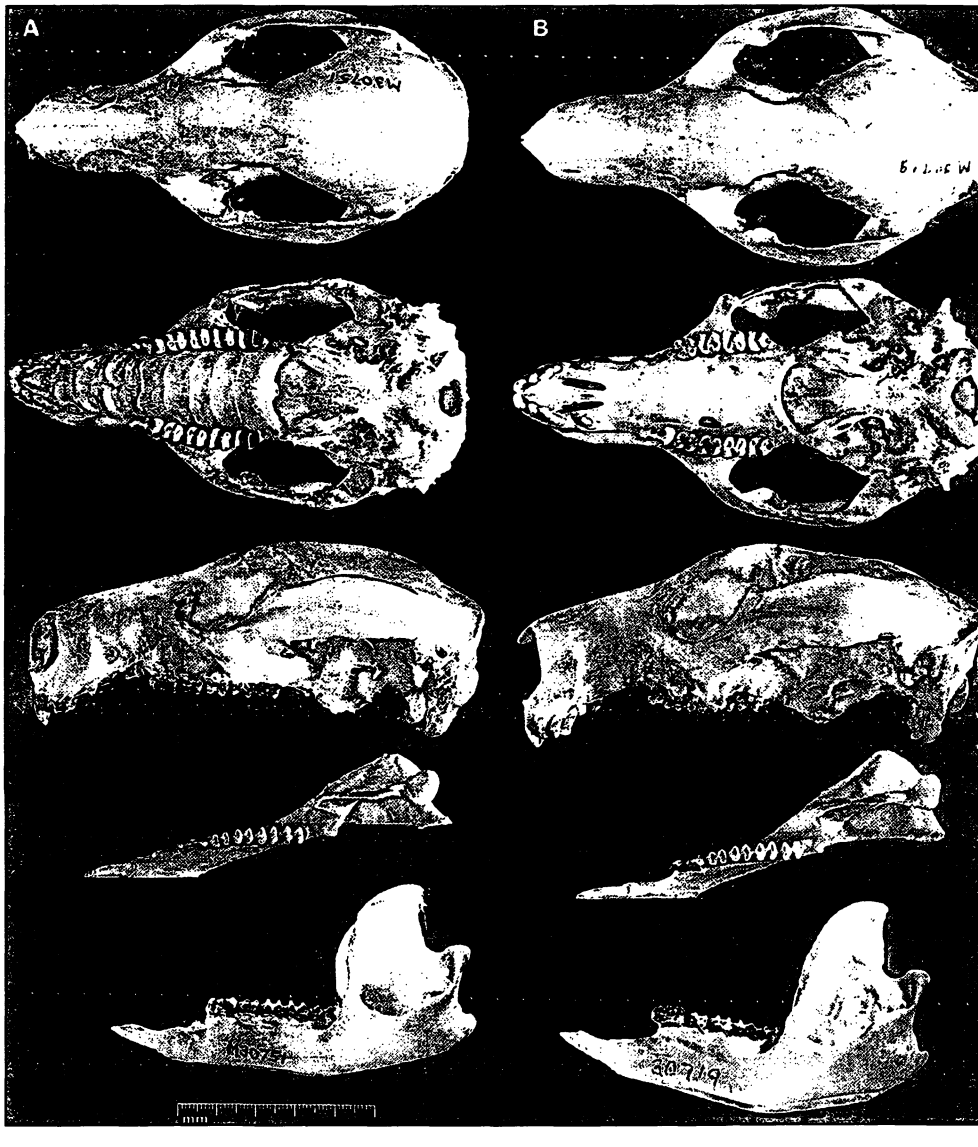

Figure 2. – Skulls in (from left) lateral, dorsal and ventral view and dentary in (from left) occlusal and lateral views of (A) AM M 30751 adult female holotype ; (B) AM M 30719 adult male paratype.

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(5) Skeleton more gracile than in other species (for example, femur length *versus* medial diameter ratio Mean = 0.86 ; all others 0.95 or greater ; Table 3).

(6) I_1P_3 diastema relatively long (Mean 13.7) ; I_1 horizontally oriented.

Description.

Pelage

The overall colour of the dorsum is blackish, but the cheeks and mid-back are variably tipped with brown. The fur is dense and up to 60 millimetres long over the midback. The ears, arms and legs are jet black, the tail black with a sprinkling of straw-coloured hairs. There is usually a tuft of long, straw-coloured hairs at the tail tip. The amount of white on the body is variable. However, a white 'star' is invariably present in adults in the middle of the forehead, and a white band rings the base of the muzzle. Judging from a photograph of a juvenile published by Nightingale (1992) and commented upon as representing a member of the *dorianus* group by Menzies (1992), juveniles lack these distinctive facial markings.

TABLE 1. – Body dimensions (in mm, weight in kg) of *Dendrolagus mbaiso*.

	Age	Head-body	Tail	Hindfoot	Ear	Weight
AM M30719	Old male	---	460	---	49	---
AM M30751	Young female	---	---	---	48	---
AM M30754	Old female	660	415	110	46	8.5 kg
AM M30749	Old female	670	520	108.2	51.7	9.0 kg
FV 1	Subadult male	580	440	99.5	53.7	5.2 kg

TABLE 2. – Cranial and dental dimensions (in mm) of *Dendrolagus mbaiso*.
The sample is limited, with the male markedly larger than the females only in bizygomatic breadth, nasal length and zygomatic height.

	Mean	Range	Standard deviation	Sample
condylobasal l.	113.8	105.6-117.4	5.51	4
rostrum w	23.2	21.5-24.7	1.31	4
bizygomatic w.	63.8	59.1-69.0	4.08	4
zygomatic h	16.9	13.0-19.2	2.75	4
nasal l	44.4	42.0-49.0	3.24	4
nasal w	18.9	18.0-19.5	0.75	4
interorbital w	18.1	16.5-19.7	1.46	4
bimastoid width	47.7	44.6-49.1	2.11	4
diastema l	13.7	12.0-14.7	1.26	4
P^3 l	9.5	9.0-9.9	0.37	4
P^3 w	5.8	5.2-6.3	0.49	4
P^3-M^5 l	35.2	34.5-36.9	1.14	4
P_3 l	9.1	8.6-9.6	0.48	4
P_3 w	3.6	3.1-4.2	0.49	4
P_3-M_5 l	34.1	33.0-35.5	1.08	4

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TABLE 3. – Summary statistics for some skeletal features of the species of *Dendrolagus*.
X = *mean* ; std = *standard deviation* ; s = *sample size*.
ben = *D. bennettianus* ; lum = *D. lumholtzi* ; inu = *D. inustus* ; urs = *D. ursinus* ; mba = *D. mbaiso* ; goo = *D. goodfellowi* ; mat = *D. matschiei* ; spa = *D. spadix* ; sco = *D. scottae* ; dor = *D. dorianus*.
(1) extent of tibia-fibula contact (in mm).
(2) femur-tibia ratio.
(3) femur length-medial breadth ratio.
(4) humeral length-distal breadth ratio.

	1			2			3			4		
	X	std	s	X	std	s	X	std	s	X	std	s
ben	48.8	11.2	2	1.065	.04	2	0.106	0.002	2	0.314	.002	2
lum	45.8	0.3	2	1.104	.03	3	0.102	0.000	2	0.300	---	1
inu	39.4	3.5	5	1.029	.01	2	0.094	0.003	3	0.318	.002	2
urs	19.4	7.1	2	0.931	---	1	0.107	---	1	---	---	-
mba	28.8	6.6	3	1.007	.02	2	0.086	0.006	3	0.325	.013	3
goo	4.4	0.3	2	1.009	.01	2	0.101	0.004	2	0.318	.017	2
mat	4.8	---	1	0.991	---	1	0.096	---	1	---	---	-
spa	---	---	-	---	---	-	---	---	-	---	---	-
sco	5.4	0.8	3	0.942	.02	3	0.095	0.003	4	0.354	.011	4
dor	4.8	0.9	5	0.926	.02	5	0.098	0.003	5	0.330	.006	5

Irregular white lines run from the corners of the mouth to the white area of the throat. The neck and lower part of the cheeks are white, as is much of the chest and belly. The inside of the limbs can also be white, and a black patch is occasionally present in the middle of the white chest (for example AM M30719). A yellowish tinge is occasionally present in the white of the venter. A small yellow patch is present at the base of the tail, but on some individuals this extends to include fully half the length of the tail.

Other features

Sparse, short vibrissae (*ca* 20 mm long) adorn the muzzle. The ears are short and, even on females, bear considerable scarring of the margin. The claws of the hands and feet are black, gracile and curved. The tail is extremely short.

Skeleton

The skeleton is gracile (for example, see Table 3). The ilium of the pelvis is flattened dorsoventrally, not triangular in cross-section as in most terrestrial macropodids and members of the primitive tree-kangaroo group. Tibia-fibula contact is moderate in extent (14.4-24.4 mm).

Skull and dentition

The skull is gracile, the rostrum being markedly narrower than in any other *Dendrolagus*. The muzzle is also sharply deflected downwards–more so than is usually seen in species of *Dendrolagus*. The skull is otherwise generally similar in shape to other species. The parietal ridges coalesce to form a sagittal crest only in males. The two lachrymal foramina are subequal in size. The zygomatic arches are high anteroventrally. The lower incisors project horizontally (not anterodorsally) from the dentary, and the diastema is relatively long. The premolars are relatively small and unornamented (Table 1, Figure 2).

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NATURAL HISTORY

Discussion.

Sexual dimorphism.

Sexual dimorphism in osteological features is limited. The single male cranium known is markedly larger than the three female crania only in bizygomatic breadth, zygomatic height and nasal length. This suggests that sexual dimorphism-at least as expressed in absolute cranial size–is slight. The male skull differs from the females in that the parietal ridges have fused to form a sagittal crest. The parietal ridges remain unfused even in the most aged females. A similar pattern (males with a parietal crest, females without) is seen in *Dendrolagus goodfellowi.*

The bones of the forearm (particularly the humerus) are substantially more robust in the male than in the females. The difference between the sexes is not as noticeable in the bones of the hindlimb. The average weight difference between the sexes is not known. However, adult females weigh 8.5-9.0 kilograms. Males could be expected to weigh a kilogram or two more.

Reproduction.

AM M30751 was nulliparous. Tooth wear reveals that she was nonetheless an aged ingividual. A thick, whitish substance was extruding from her cloaca. This may have been the result of chronic infection of the reproductive tract which had resulted in infertility.

AM M30754 had reproduced, but when caught on 21 or 22 May the pouch was vacant and she was not being accompanied by a young. She was not lactating, but hairs around the pouch were stained a bright salmon colour. Similarly, AM M30749 had suckled young, but she was not lactating, and was alone when captured in the Kwiyawagi area on 14 June 1994.

Little can be said of reproduction. It is possible that breeding is seasonal, and that our visit coincided with the end of the breeding cycle. Our sample size however is too small (two fertile adult females) to speculate further.

Social structure.

The only adult male captured (an old adult) was alone ; AM M30754 was accompanied by a male which escaped ; AM M30751 and AM M30749 were alone. These few data suggest that *Dendrolagus mbaiso* is not a highly social species. FV 1, a subadult male, was found sheltering alone in a disused building at 3,700 metres elevation at the Freeport mine. It appears probable that it was a migrant seeking habitat not occupied by resident males.

Behaviour.

Dendrolagus mbaiso is believed by local hunters to be largely terrestrial. They say that it never leaps from the trees to the ground, but instead climbs down backwards in much the same manner as a human. The trees which characterise its habitat near Tembagapura and Kwiyawagi are stunted subalpine species. Near Pogapa, where it is not hunted, it is reputed to occur in taller forest at lower elevation.

Aspects of its morphology support the contention that it is largely terrestrial. Its limb bones are gracile when compared with those of other tree-kangaroos. It is unlikely that they are robust enough to withstand the leaps of up to 30 metres from the canopy

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that some other species undertake. Another characteristic which suggests that it has a relatively terrestrial life is the great length relative to breadth of the proximal epiphysis of the tibia (Table 5). Similar proportions are seen in terrestrial macropodids (Flannery and Szalay 1982), but not other tree-kangaroos.

Dendrolagus mbaiso is extremely tame. It will sometimes approach a hunter who is holding a leaf out to it, and is usually captured by slipping a noose over its head. This could never be done with *D. dorianus*, which is much more wary. A wild subadult male allowed itself to be picked up and carried into an office.

It is, in contrast to *Dendrolagus dorianus*, almost odourless, with only a faint sweetish smell on the chest of adult females, and a faint musky smell on the body of a

TABLE 4. – Ratio of tail to head-body length for species and subspecies of *Dendrolagus*.
Sources of measurements include in addition to those listed in the Appendix : Laurie (1952), Rothschild & Dollman (1936), Groves (1982) and Martin (1992).

	Mean	STD	Sample
Dendrolagus bennettianus	1.19	0.10	12
Dendrolagus inustus			
inustus	0.95	0.02	2
finschi	1.13	0.10	8
Dendrolagus lumholtzi	1.18	0.12	6
Dendrolagus ursinus	1.06	0.05	4
Dendrolagus mbaiso	0.71	0.11	2
Dendrolagus dorianus			
dorianus	0.85	0.12	7
notatus	0.81	0.08	19
stellarum	0.83	0.08	4
mayri	0.90	----	1
Dendrolagus goodfellowi			
goodfellowi	1.22	0.17	2
buergersi	1.17	0.09	16
pulcherrimus	1.19	0.08	2
Dendrolagus matschiei	1.00	0.10	12
Dendrolagus scottae	0.81	0.06	8
Dendrolagus spadix	1.20	1.00	3

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subadult male. The gut is expansive–appearing on casual inspection to be larger than that of *D. dorianus*. In support of this, it was found that meat and bone constituted between 57 % and 61 % of the carcass weight in adult male *D. dorianus* (n = 2) ; but only 47 % in an adult female *D. mbaiso*. The gut makes up most of the remaining weight.

TABLE 5. – Characters used in the cladistic analysis.
Petrogale was used as an outgroup. P = primitive state.
ben = *D. bennettianus* ; lum = *D. lumholtzi* ; inu = *D. inustus* ; urs = *D. ursinus* ; mba = *D. mbaiso* ; goo = *D. goodfellowi* ; mat = *D. matschiei* ; spa = *D. spadix* ; sco = *D. scottae* ; dor = *D. dorianus*.

External
1) hair-whorl position: over shoulders; lower on back
2) tail length (relative to head-body): subequal/longer than head-body; shorter
3) hindfoot: relatively elongate, short and relatively broad
4) fourth toe of hindfoot: much longer than fifth; shorter
5) tail without; with white tip
6) forehead dark; contrasting pale and dark

Skeletal
1) tibia-fibula contact: < 7 mm; > 20 mm, > 35 mm
2) femur length versus breadth at mid-point less than 0.09; greater
3) femur-tibia ratio: > 1.02; < 1.02; < 1.00
4) calcaneal—astragalar facet: runs transversely; diagonally
5) ileum: triagular in cross section; flattened
6) ratio of humeral length to distal breadth: .320 or less; greater
7) pit at proximal end of femur: deep, narrow; shallow, broad
8) depression between condyles of proximal femur: deep, shallow, very shallow
9) proximal tibia length/breadth > 86, < 86, < 81

Cranial
1) I_1 lying flat; slightly inclined anterodorsally; steeply inclined
2) fusion of sagittal crest: in neither sex; in males; both sexes
3) lachrymal foramina: subequal in size; inferior much larger

	ben	lum	inu	urs	mba	goo	spa	mat	dor	sco
E1	p	p	p	p	p	1	1	1	p	p
2	p	p	p	p	1	p	p	p	1	1
3	p	p	p	1	p	2	2	2	2	2
4	p	p	p	1	1	1	1	1	1	1
5	p	p	p	p/1	1	p	p	p	p	p
6	p	1	1	p	p	p	p	p	p	p
S1	p	p	p	1	1	2	*	2	2	2
2	1	1	1	1	p	1	*	1	1	1
3	p	p	p	2	1	1	*	2	2	2
4	p	p	p	*	1	1	*	*	1	1
5	p	p	p	p	1	1	*	p	1	1
6	p	p	p	*	1	p	*	*	1	1
7	p	p	p	*	2	1	*	*	1	1
8	p	p	p	*	1	p	*	*	2	2
9	p	1	p	1	p	1	*	*	1	2
C1	1	1	1	1	p	1	1	1	2	2
2	p	p	p	p	1	1	p	2	2	2
3	p	p	p	p	p	p	p	p	1	1

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Dendrolagus mbaiso has a distinctive call, reputed by local hunters to be a repeated, whistling sound, or a high-pitched *hue, hue*-like note. This appears to be unique within the genus. T.F. has observed *D. dorianus, D. scottae, D. goodfellowi, D. inustus* and *D. ursinus*. All of these species are either silent or produce a snuffling sound or grind their teeth when disturbed.

Habitat and distribution.

Dendrolagus mbaiso is restricted to the southern and western slopes of the Surdirman Range. Our westernmost records are from the Pogapa area (03°45'S ; 136°51'E), while our easternmost ones are from the Kwiyawagi area (04°01'S ; 138°12'E). Despite this, the species is almost certainly distributed from approximately 136°30'E to 139°10'E–that is along the entire length of the Sudirman Range, from the Paniai Lakes region in the west to the Baliem Gorge in the east. According to Moni, Damal and Dani informants, it is distributed from Gunung Dolepieu (elevation 3,965 metres), which lies east of Paniai, to Gunung Trikora (elevation 4,750 metres) or the Baliem Valley to the south of Wamena.

Its distribution thus extends in a normally narrow band over some 200 kilometres in an east-west direction. We have recorded it at an elevation of 3,250-4,200 metres, but it probably occurs as low as 2,700 metres, wherever suitable low mossy forest or scrub (and possibly rocky areas) exist. Depending upon its precise elevational limits, it occurs over an area of approximately 2,000 to 4,000 square kilometres of habitat.

We do not know whether it occurs east of the Baliem River, but this seems unlikely. It does not occur in the Star Mountains of the Irian Jaya-Papua New Guinea border region (Flannery and Seri 1990b).

The habitat of *Dendrolagus mbaiso* falls largely within the territories of two major and two minor language groups. The Western Dani are by far the largest group. They inhabit most of the distribution of *D. mbaiso* east of approximately 137°E. They, along with the smaller Amungme group (Tembagapura area) and the Nduga (Mapnduma area) have few or no taboos concerning its hunting. As a probable consequence, *D. mbaiso* is now rare throughout most of the territories of these people. Within this vast region, it has, within living memory, been restricted to the upper slopes of the southern fall of the range. At Kwiyawagi (in Dani territory) it appears to be extinct within approximately two days' walk of the settlement, although older informants remembered it once being abundant in suitable habitat in their area. They attributed its decline to human population growth and an increase in the number of hunting dogs in the area.

The remaining major language group, the Moni, occupy much of the region lying west of 137°E. They observe traditions which act to conserve *Dendrolagus mbaiso*. Within their region it appears to remain common, and there it may occasionally descend to elevations as low as 2,700 metres. It also occurs on the more gentle western and north-western falls of the range in this area. Its persistence there would appear to be related to the degree of protection afforded it by Moni tradition.

Three of the specimens reported upon by us were collected on the upper slopes of Gunung Ki, in extremely mossy forest (canopy height *ca* 7 metres) growing on extremely rugged, rocky slopes. Gunung Ki lies just west of Grasberg, and access to this area is now denied traditional hunters due to the heavy mining equipment in the area and its nearness to the Freeport mines. This may have preserved the population of *Dendrolagus mbaiso* on Gunung Ki, for it is far more common at this locality than else where within the lands of the groups which do not practice traditional conservation.

Thus far, we have located *Dendrolagus dorianus* at elevations of between 2,300 and 2,700 in the Sudirman Range. Hunters say that both species occur together in parts

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of the region, although thus far we have no other evidence that they do in fact occur in sympatry.

Diet.

Little was learned of the diet of *Dendrolagus mbaiso*. It is almost certainly folivorous, and Moni informants suggested that it consumed the leaves of understorey plants known to them as *so jabi*. A captive animal was fond of the immature fronds of a fern of the genus *Blechnum* and thrived on a diet of leaves collected from secondary growth plants growing at approximately 2,000 metres elevation.

ETHNOGRAPHIC NOTES

While many of the traditional beliefs and practices of the small-scale societies inhabiting the Sudirman Range have been eroded or discarded in the processes of missionisation and development, we discovered during our fieldwork that those traditions regarding the consumption of game meat were generally the most persistent in the everyday lives of the Moni, Damal (Amungme) and Dani men and women we interviewed. Our perception of the strength of this impression may be an artefact of the nature of the work we were undertaking, but may also be due to the fact that as a result of cultural change, hunting in some areas is no longer the common everyday occupation it was traditionally and when game meat is acquired, traditional values and practices are adhered to automatically. In particular, we found that Moni beliefs concerning *Dendrolagus mbaiso* remain strongly held.

Ethnotaxonomy.

Dendrolagus mbaiso is known to several language groups inhabiting the mountain villages of the Sudirman Range. Damal (Amungkal speakers) of the area surrounding Tembagapura know this animal as *Nemenaki* ; *D. dorianus* is referred to as *Naki.* To Western Dani speakers from Ilaga and Kwiyawagi, *D. mbaiso* is known as *Wanun* and *D. dorianus* as *Waya.* To the Nduga of Mapnduma, *D. mbaiso* is *Itimili.*

The Moni people, whose territories lie east of Paniai Lakes, know *Dendrolagus mbaiso* by three names–two secular and one sacred. *Dingiso,* meaning 'large black game animal' is the Moni common name for this tree-kangaroo ; *Mayamumaya,* an alternative name, means 'the one who has received the face of a man'. The third name, *Bondegezou,* is a term of deep respect used by Bibida Moni to whom the hunting and eating of this animal is forbidden. *Bondegezou* is seldom used in everyday speech and means 'man of the alpine forest' (*bondege* = mossy, stunted alpine forest).

Cultural significance of Dendrolagus mbaiso among Moni.

Dendrolagus mbaiso figures prominently in Moni cosmology. Its hunting and eating is forbidden to members of serveral descent groups, referred to here (possibly inadequately) as 'clans' (see Table 6). For these individuals, *D. mbaiso* is the ancestral being from whom they are descended and the animal may be neither harmed nor taken as food. The significance of this restriction is reflected in the meaning of the sacred name *(Bondegezou)* and alternative name *(Mayamumaya)* among those to whom it is forbidden, both of which refer to the animal anthropomorphically.

For those Moni who trace their descent from *Dendrolagus mbaiso,* to kill and consume it would be to destroy and ingest one's spiritual progenitor, the source of one's being. We found among our informants that such beliefs are upheld by both young and

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old Moni, many of whom otherwise regard themselves as Christians. One elderly informant, Bogabau Ba Bolobau of Pogapa, when asked if he knew the animal replied, « Yes, I know it. This animal is my nose ». The reference to the nose is the Moni expression for the source of the individual's personal sense of being-in-the-world. « This animal is my nose » literally means « This animal is the centre of my being ».

According to Moni tradition, transgressors of the restriction regarding *Dendrolagus mbaiso* are said to vomit up its claws (although the claws of tree-kangaroos are normally never consumed) and fur mixed with blood, and to suffer terrible bleeding from the nose. Worms and the understorey plant *so jabi* (unidentified) – materials understood by Moni to be the foods of *D. mbaiso* – are also vomited. Additionally, the well-being of the lineage to which one belongs is placed in jeopardy.

Moni restrictions regarding *Dendrolagus mbaiso* appear to function matrilineally, with clan membership traced through the maternal line. One of our most helpful informants, an experienced and extremely bright Moni man in his early 30s, living and working at Tembagapura, explained that although his name was Zonggonau (a clan permitted to hunt *D. mbaiso*), his mother's clan (Kobogau) was among those to whom *D. mbaiso* is forbidden , thus he, in turn, was also forbidden it.

Dendrolagus mbaiso, he said, was *Ago mbaiso* ('my forbidden animal') and he recalled as a child being led away from a tree-kangaroo feast by his mother, who told him « Come away, we must not watch this ». While able to assist us in the field with specimens of other species we collected, Zonggonau could not participate in the hunting of *D. mbaiso,* nor in the distribution of its meat. Indeed, when our Dani and Amungme hunters returned with the first complete specimen of *D. mbaiso* we obtained, without discussion Zonggonau walked away from our camp into the surrounding forest, returning (again without discussion) only when the animal had been processed and packed into a collecting drum.

According to Moni tradition, among those to whom the species is permitted, *Dendrolagus mbaiso* is able to be hunted successfully only by those destined to become headmen or clan leaders. Only those individuals whose dreams or visions will become reality, it is thought, are able to find *D. mbaiso.* Traditionally, the fur of this species was sewn onto a backing of pandanus and worn on the head by men of proven status, to whom the fur was thought to impart strength. Such headdresses are not uncommon in the highlands of Irian Jaya, usually incorporating the fur of *Dendrolagus dorianus* (Szalay 1993). However, Dani and Moni informants remarked that the use of such headdresses today in many instances signified pretension to the traditional status rather than legitimate attainment.

Although members of several Moni clans are permitted to hunt and consume the meat of *Dendrolagus mbaiso* (see Table 6), such practices have diminished in frequency over time. Our informants explained that when *D. mbaiso* is brought into the village, those to whom it is forbidden leave the scene ; when it is being cooked in the village, the revulsion felt by those to whom it is their ancestor discourages others from enjoying the meal. The sharing of food is a central tenet in most New Guinea cultures ; among the Moni, it is a fundamental principle underpinning social life. For Moni, butchering, cooking and eating *D. mbaiso* at best offends the laws of human commensality, at worst it is a reviled act of cannibalism.

Significance among Amungme.

Among the Damal (Amungkal speakers), we obtained the name of only one clan to whom *Dendrolagus mbaiso* is forbidden (Table 6) ; the remainder of the clans listed by our informants were permitted to hunt and eat this species. However, it should be

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noted that Amungme women were traditionally denied all game meat ; their only source of animal protein being obtained from the frogs they caught while gardening and from pork distributed on specific occasions. One informant, an Amungme woman aged in her late 40s living at Tembagapura, told us that although the traditional restrictions preventing Amungme women from eating game meat had been considerably relaxed in the wake of missionisation and development, she herself still did not and would not partake of game meat.

TABLE 6. – Hunting and consumption of *Dendrolagus mbaiso*.
The table shows the names of those descent groups/clans to whom this is permitted or forbidden.

Language group	Clan	Forbidden	Permitted
Amungme	Pam Natkime	X	
	other clans		X
Moni	Agimbau		X
	Bagau	X	
	Belau	X	
	Dendegau	X	
	Dimbau	X	
	Duwitau		X
	Hagimuni		X
	Holombau	X	
	Janambaui	X	
	Japugau		X
	Kobogau	X	
	Miagoni		X
	Migau		X
	Nagapa		X
	Sani	X	
	Selegani		X
	Somau	X	
	Sondegau		X
	Tipagau	X	
	Ugipa		X
	Wabelau		X
	Wamuni	X	
	Wandagau		X
	Zagani		X
	Zonggonau		X

Significance among Dani.

Among the Western Dani of Ilaga and Kwiyawagi there appear to be no strongly held beliefs restricting the hunting of *Dendrolagus mbaiso* . Lani women of Kwiyawagi are not permitted its meat as food ; they are also forbidden the meat of *D. dorianus*. Lani hunters were unanimous in their assertions that *D. mbaiso* could not be found nearer than two days' walk from the settlement at Kwiyawagi.

Descriptions and interpretations of the behaviour of Dendrolagus mbaiso.

Almost all accounts of *Dendrolagus mbaiso* obtained by us made mention of the tameness of the animal. Dani and Moni informants both remarked that is would take

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leaves from a hunter's hand when encountered on a path in the forest. Dani and Amungme hunters described a common method of capture using a noose of rattan attached to a length of tree-branch ; the noose is directed over the head of the animal, the free end is pulled, the noose is tightened, and the animal is then led away. The contrast with *Dendrolagus dorianus* in its demeanour and behaviour was frequently made, with *D. dorianus* being regarded as more wary and aggressive.

Moni remarked that hunting dogs would sometimes turn away from *Dendrolagus mbaiso* if they came upon it unexpectedly on a path in the forest – approaching it but stopping suddenly and lying down – a response interpreted by Moni as the dog's instinctive knowledge not to harm the animal. When encountered in the forest by a Moni hunter to whom it is forbidden, *D. mbaiso* is said to stand up on the path, raise its forearms upwards and emit a shrill, whistling call. This behaviour is interpreted by Moni as an explicit sign of the animal's recognition of the hunter's clan identity.

When encountered in the forest at night, *Dendrolagus mbaiso* is said by Moni and Dani to cover its eyes with its hands against the bright light of a hunter's fire-torch.

EVOLUTIONARY RELATIONSHIPS

The earliest attempt to determine relationships within the species of *Dendrolagus* is that of Rothschild and Dollman (1936). In a pre-cladistic study, they grouped the seven species then known into three sections based upon the position of the hair whorl and colour of the fur. *Dendrolagus matschiei* and *D. goodfellowi* were united on the basis of their possession of a hair whorl in the centre of the back and a reddish coat. *Dendrolagus dorianus* was placed in its own group based upon the position of the hair whorl near the base of the tail, its brown or grey colour and its pale caudal spot. *Dendrolagus ursinus, D. inustus, D. bennettianus* and *D. lumholtzi* were united in a third group based upon the position of the hair whorl near the shoulders and a coat of black, brown or grey.

Groves (1982) and Flannery and Szalay (1982) both observed that the species of *Dendrolagus* could be divided into two distinct groups : a plesiomorphic, possibly paraphyletic one ; and a monophyletic derived group. Groves noted that *D. ursinus, D. matschiei, D. goodfellowi* and *D. dorianus* share the following derived features : (1) short feet ; (2) a shortened middle toe of the foot ; (3) a P^3 with a posterior prominence broken into three lobes and a cross-shaped anterior prominence ; (4) shortened nasals ; (5) deep face ; (6) internally furry ears ; and (7) a posteriorly positioned hair whorl. He further noted that *D. inustus* and *D. lumholtzi* share the possibly derived features of a light forehead patch, a somewhat broadened snout, and medially constricted nasals.

Flannery and Szalay (1982), in their description of a gigantic, plesiomorphic fossil tree-kangaroo *(Bohra paulae),* noted several features that may be important in determining relationships within *Dendrolagus*. They showed that *D. lumholtzi, D. inustus, D. bennettianus* all possessed an extensive area of contact between the distal ends of the tibia and fibula. In contrast, in *D. goodfellowi, D. matschiei, D. dorianus* and *D. ursinus* it is more restricted. They also showed that the species of *Dendrolagus* and the fossil *Bohra* all possess a uniquely flattened calcaneum with an open calcaneal-cuboid facet, a relatively short calcaneum, a medio-laterally oriented facet on the calcaneal head, and a short proximal tibial epiphysis. These findings support those of Groves (1982), in that they result in recognition of the same plesiomorphic and derived groups.

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While many of the characteristics examined by Groves (1982) and Flannery and Szalay (1982) have some value phylogenetically, some have proved difficult to quantify across the genus and so are not represented in our phylogenetic analysis. The characters which we examined in this study appear to be constant between species and most are readily quantified. They are drawn from external morphology, postcranial osteology (the majority) and cranial morphology and dentition.

We undertook a cladistic analysis using PAUP 3.1.1. The characters used are shown in Table 5. Characters S1-3, S6-9 and C1 were ordered, the rest unordered. No further data manipulation was carried out, as it was felt that careful analysis of the trees produced would be more useful than altering the data set further.

The species of *Petrogale* were used as an outgroup. Ziegler (1977) was the first to suggest a close relationship between *Petrogale* and *Dendrolagus*, although he did not substantiate his claim. Subsequently, Baverstock *et al.* (1989), in an albumin immunological study, suggested that *Petrogale* (with *Thylogale*) and *Dendrolagus* are very closely related. Recently, Kirsch *et al.* (in press), in a study using DNA hybridisation, have provided further evidence that *Dendrolagus, Petrogale* and *Thylogale* do indeed form a monophyletic group. Interestingly, some members of the genus *Petrogale* can climb trees. They and the monotypic *Setonix* are the only macropodoids apart from the species of *Dendrolagus* which are reported to do so.

The Strict consensus and Majority rule trees produced by this procedure are shown in Figure 3. Both trees agree in general structure in that the three species *bennettianus, lumholtzi* and *inustus* are shown as being (in different combinations) the plesiomorphic sister groups to the remaining species. This finding supports in part both the work of Groves (1982) and Flannery and Szalay (1982), who also discerned a plesiomorphic (possibly paraphyletic) group consisting of *bennettianus, lumholtzi* and *inustus*, and a derived clade consisting of all other species.

Both trees also agree in placing *dorianus* and *scottae* together as a highly derived terminal twig. This finding is consistent with the work of Flannery and Seri (1990a), who consider these taxa to be sister species.

There is considerable uncertainty in the PAUP analysis concerning the remaining taxa. The Strict consensus tree placed all other taxa in an unresolved polychotomy with the *dorianus/scottae* clade. This is, we feel, with a single exception, a realistic if perhaps conservative estimate. The exception concerns the taxa *matschiei, goodfellowi* and *spadix*. We suspect that they are monophyletic. They share a unique hair whorl position (Rothschild and Dollman 1936), and are phenetically very similar; so much so that they were lumped into a single species by Groves (1982).

The Majority rule tree places *mbaiso* as the sister taxon to the *scottae/dorianus* clade, with *goodfellowi* the sister taxon to those three. Following this is an unresolved trichotomy involving this group, *matschiei* and *spadix*. *Dendrolagus ursinus* is placed as the sister taxon to all of these.

Eighteen trees of an equally short length (36 steps) were generated by the analysis. They produced a number of different configurations. Among the most variably placed of all taxa was *Dendrolagus mbaiso*. Most (89 %) of the trees indicated (as shown by the Majority rule tree) that it is the sister taxon of the *dorianus/scottae* clade. But a few, equally parsimonious, trees suggested that it is the sister group to all other members of the 'derived clade'.

Those trees that place *Dendrolagus mbaiso* as the sister taxon to the *scottae/dorianus* clade assume that its long hindfoot, short fifth toe, relatively extensive tibia-fibula contact, less robust femur, relative shallow sulcus at the proximal end of the femur and relatively anteroposteriorly elongate proximal tibial epiphysis are due to reversion to

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the plesiomorphic condition. Those which place it as the sister taxon to the remaining members of the 'derived group' must account for its short tail, flattened ilium, the presence of a sagittal crest in the male and its white tail tip as being convergent upon the condition seen in various other members of the derived group.

An analysis of the characters used in this study, along with what little is known of the lifestyle of *Dendrolagus mbaiso*, allows us to consider where convergence is most likely to have occurred. *Dendrolagus mbaiso* is unusual in the genus in that, from all accounts, it is largely terrestrial. Some features, such as its gracile skeleton, suggest

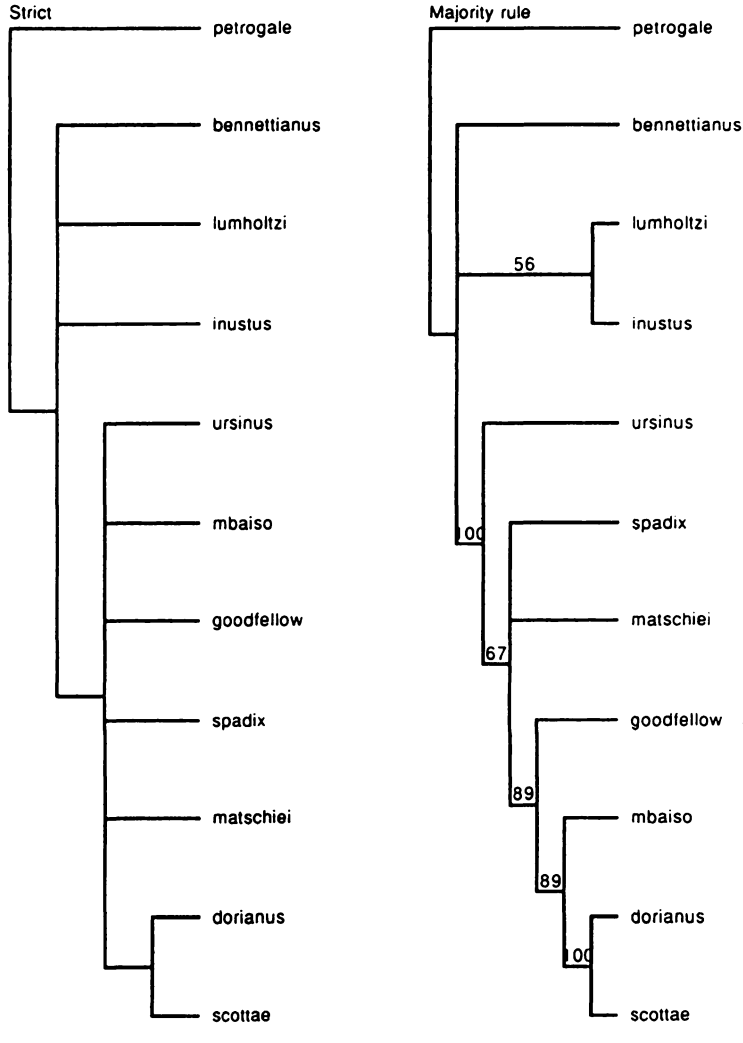

Figure 3. – Cladograms for the species of *Dendrolagus* produced by PAUP. The Strict concensus tree probably more accurately reflects our understanding of the evolutionary relationships of the members of the genus at present.

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that it is incapable of the great leaps from the canopy that form part of the behavioural repertoire which relate to an arboreal lifestyle in other species. In its gracile skeleton, relatively long hindfoot, relatively extensive tibia-fibula contact and elongate proximal tibia epiphysis, it more resembles terrestrial kangaroos (or plesiomorphic tree-kangaroos) than members of the 'derived group' within *Dendrolagus*. In some of these features (for example, the gracile skeleton, long proximal tibia epiphysis) it is more like terrestrial kangaroos than any other tree-kangaroos.

If these characters have not resulted from convergence, they can only be accounted for by having persisted from a non-arboreal ancestor. This seems unlikely, for *Dendrolagus mbaiso* lacks some of the truly primitive features (such as a very extensive tibia-fibula contact) seen in undoubtedly plesiomorphic species such as *D. bennettianus*. The loss of an extensive tibia-fibula contact is clearly related to the need to rotate the foot so that the soles can be opposed when climbing. To find the derived condition (limited contact) in a character which is so clearly related to arboreality in a predominantly terrestrial species suggests to us that its terrestrial lifestyle is largely secondary. This in turn suggests that its other features which relate to a terrestrial lifestyle are secondarily derived. In summary, we suggest that *D. mbaiso* is a close relative of the *D. dorianus*/*D. scottae* clade which has experienced reversion to the primitive condition in a number of features as a result of its largely terrestrial lifestyle.

The putative reversion to a terrestrial lifestyle in *D. mbaiso* is interesting in terms of macropodoid evolutionary history. The macropodoids appear to have been derived from arboreal possum-like ancestors (Flannery 1987). In their adaptation to a terrestrial lifestyle they lost many arboreal adaptations, including a prehensile tail and hallux. Members of the genus *Dendrolagus* are secondarily arboreal, having been derived from terrestrial ancestors (Baverstock *et al.* 1989). Almost all are capable climbers ; even the most plesiomorphic (such as *D. bennettianus*) spend long periods in the canopy (Martin 1992). Finally, one lineage within the genus *(D. mbaiso)* has re-adapted to a terrestrial existence. The redevelopment of many aspects of anatomy that these changes have involved suggest that Dollo's Law (at least as conventionally understood) does not apply in kangaroo evolution.

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BIBLIOGRAPHY

BAVERSTOCK, P.R., B.J. RICHARDSON, J. BIRREL and M. KREIG, 1989. – Albumin immunologic relationships of the Macropodidae (Marsupialia). *Systematic Zoology*, 38 : 38-50.

FLANNERY, T.F., 1987. – The relationships of the macropodoids (Marsupialia) and the polarity of some morphological features within the Phalangeriformes. Pp. 767-771 *in* : *Possums and Opossums, Studies in Evolution*. Ed. M. Archer, Surrey Beatty and Sons, Chipping Norton, NSW.

FLANNERY, T.F., 1993. – Taxonomy of *Dendrolagus goodfellowi* (Macropodidae : Marsupialia) with description of a new subspecies. *Records of the Australian Museum*, 45 : 33-42.

FLANNERY, T.F., and L. SERI, 1990a. – *Dendrolagus scottae* n.sp. (Marsupialia : Macropodidae) a new tree-kangaroo from Papua New Guinea. *Records of the Australian Museum*, 42 : 237-245.

FLANNERY, T.F., and L. SERI, 1990b. – The mammals of southern West Sepik Province, Papua New Guinea, their distribution and abundance, with notes on the zoogeography of northern New Guinea. *Records of the Australian Museum*, 42 : 173-208.

FLANNERY, T.F., and F.S. SZALAY, 1982. – *Bohra paulae*, a new giant fossil tree-kangaroo (Marsupialia : Macropodidae) from New South Wales, Australia. *Australian Mammalogy*, 5 : 83-94.

GROVES, C.P., 1982. – The systematics of tree-kangaroos (*Dendrolagus* : Marsaupialia : Macropodidae). *Australian Mammalogy*, 5 : 157-186.

KIRSCH, J.A.W., F.-J. LAPOINTE and A. FOESTE, in press. – Resolution of portions of the kangaroo phylogeny (Marsupialia : Macropodidae) using DNA hydridisation. *Biological Journal of the Linnean Society*, London.

LAURIE, E.M., 1952. – Mammals collected by Mr Shaw Mayer in New Guinea 1932-1949. *Bulletin of the British Museum (Natural History)*. Zoology, 1 : 269-318.

MARTIN, R., 1992. – An ecological study of Bennett's Tree-kangaroo *(Dendrolagus bennettianus)*. *WWF Australasia Report*, Project 116.

MENZIES, J.I., 1992. – A tree-kangaroo *(Dendrolagus* sp.) from the highlands of western New Guinea. *Science in New Guinea*, 18 : 94.

NIGHTINGALE, N., 1992. – Land of the Big Pigeon. *BBC Wildlife* 10 : 44-50.

ROTHSCHILD, W. and G. DOLLMAN, 1936. – The genus *Dendrolagus*. *Transactions of the Zoological Society*, London, 1936 : 478-548.

SZALAY, A.L., 1993. – Tracing the decline of endangered rainforest mammals of Melanesia : a new approach using ethnographic artefacts in museum collections. *Unpublished Esso Australia Scholarship Report*, Australian Museum, Sydney.

ZIEGLER, A.C., 1977. – Evolution of New Guinea's marsupial fauna in response to a forested environment. Pp. 117-138 *in* : *The Biology of Marsupials* Eds Stonehouse and Gilmore. MacMillan, London.

APPENDIX

Specimens of *Dendrolagus* examined during this study.

Dendrolagus bennettianus M 907 ; M 908 ; M 1228 ; M 1229 ; M 1818 ; M 1820 skin, skull : Bloomfield River, Queensland, Australia. M 11638 skull : Thornton Peak, north-west of Cairns, Queensland, Australia. M 23242 spirit pouch young : Shiptons Flat, near Cooktown, Queensland, Australia. S 488 gallery skeleton : Bloomfield River, Queensland, Australia.

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Dendrolagus dorianus dorianus M 1048 skin, skull; M 1049 skin: Astrolabe Range, New Guinea. M 2219 skin, skull: 120 metres, Mt Kebea, St Joseph River, Kuni District, New Guinea. M 2644 flat skin: Awai River, tributary of Musa River, North-east Division, Papua. M 2706 skin, skull: Elevation 4000 feet, Mafula District, 50 to 60 miles inland from Yule Island, South-east Papua. M 2804, M 2805 skin, skull: Balatana, Owalama Range, North-east Division, Papua. M 4560 skin; M 6302 skin, skull: Edie Creek Goldfield inland from Salamoa Bay, Papua. M 12854 skin, partial skeleton; M 12916 mandibles: Mt Albert Edward, 112 km north of Port Moresby, Central Province, PNG.

Dendrolagus dorianus notatus M 7304, M 7597, M 7488, M 7868, M 7931, M 7932, M 8466 skull, skin; M 9109 skull, skeleton: Locality unspecified. M 7387, M 7406, M 7418, M 7576, M 7273, M 7391, M 7537, M 7577, M 7578, M 7790, M 9103 skin, skull: Mt Hagen District, New Guinea. M 15722, M 15723 skull; M 16419, M 17374 skin, skull; M 17153, M 17746 spirit: Mt Sisa area, Southern Highlands Province, PNG.

Dendrolagus dorianus stellarum M 16699 skin, skull: Sol River Valley, Telefomin, Sandaun (West Sepik) Province, PNG. M 17789, M 17790 skin, skull; M 19463 spirit: Dokfuma area, Star Mtns, Western Province, PNG. M 30720 skull, part skeleton: Gunung Ki, Tembagapura area, Irian Jaya. M 30733 skin only: South of Kwiyawagi, near Mapnduma, Irian Jaya. M 30750, M 30753 skull, part skeleton, skin: Forest at Mile 61, Tembagapura area, Irian Jaya.

Dendrolagus goodfellowi buergersi M 6509 skin, skull: Wau, Morobe Division, New Guinea. M 7221 skin, skull: Near Mt Jaka, New Guinea. M 7416, M 7417, M 7535, M 7536, M 7580 skin, skull: Mt Hagen District, New Guinea. M 17213 skin, skull; M 18639 spirit: Yominbip, Thurnwald Range, Sandaun (West Sepik) Province, PNG. M 17222 skull: Head of Skgonga River, Sandaun (West Sepik) Province, PNG. M 17620 skin, skull: Mt Miak, Thurnwald Range, Sandaun (West Sepik) Province, PNG. M 24631 skull (no mandible): Tibip Village, near Skgonga River, Yapsiei area, Sandaun (West Sepik) Province, PNG. M 7497, M 29689, M 29690 skin: Locality unspecified. M 7574, M 7575, M 7586, M 7598, M 9145, M 23548 skin, skull, M 23632 skull, skeleton, M 24495 skull: Locality unspecified.

Dendrolagus goodfellowi goodfellowi M 29227 skin, skull: Eastern slopes of Mt Victory, Kwin River area, Oro Province, PNG.

Dendrolagus goodfellowi pulcherrimus M 21717 skin, skull; M 22173 skull: Sibilanga area, Sandaun (West Sepik) Province, PNG. M 23423 spirit: Mt Machold, Torricelli Mtns, Sandaun (West Sepik) Province, PNG.

Dendrolagus Inustus finschi M 21866 skin, skull; M 23554 skull, M 24641, M 24643 skull (complete); M 24642 (no mandible): Sibilanga area, Sandaun (West Sepik) Province, PNG. M 21868, M 24632, M 24634, M 24635, M 24636, M 24637, M 24638, M 24639, M 24640 skull (no mandible); M 24633 mandible only: Imonda area, Sandaun (West Sepik) Province, PNG. M 23020 spirit; M 21840 skin, skull: North slope of Mt Somoro, Torricelli Mtns, Sandaun (West Sepik) Province, PNG. M 23422 skin, skull: Mt Kalbim, Torricelli Mtns area, Sandaun (West Sepik) Province, PNG. M 24192, M 24425, M 24426 spirit; M 24437 skin, skull; M 25385 skull: Headwaters of Nengo River, Torricelli Mtns, Sandaun (West Sepik) Province, PNG. M 25390, M 25434 skin, skull, skeleton: Sweipini area, Torricelli Mtns, Sandaun (West Sepik) Province, PNG. M 17149 juvenile, spirit: Pual River, near Vanimo, Sandaun (West Sepik) Province, PNG. M 7265 skin, skull: Hollandia, Dutch New Guinea.

Dendrolagus lumholtzi M 395 gallery: North Queensland, Australia. M 498, M 500 skin, skull; M 23935 skull (no mandible); M 499 mounted skin; M 501, M 502 gallery: Herberton District, Queensland, Australia. M 1683 skin, skull: Russell River, near Cairns, Queensland, Australia. M 2272, M 2273, M 3344 skin, skull; S 1621, S 1622, S 1623 skull only: Bellenden Kerr Range, Queensland, Australia. M 2287 skin, skull: Mt Bartle Frere, Queensland, Australia. M 6871 skin, skull: Wondecla, Atherton Tableland, Queensland, Australia. M 9102, M 9108 skin, skull, skeleton: Atherton, Queensland, Australia. M 23184 spirit: Crater National Park, Atherton Tablelands, Queensland, Australia. M 18318, M 18319, M 18320, M 18321, M 18322, M 18323, M 18385, M 18386, M 18387 spirit: Ravenshoe, Queensland, Australia. S 1929 skull only: Queensland, Australia. M 6213 skin, skull; M 2098, M 2802 skin, skull, M 6214 spirit: Locality unspecified.

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Dendrolagus matschiei M 3799, M 4032, M 4195, M 4205, M 4320 skin, skull : Rawlinson Mtns, New Guinea. M 6478, M 6812 skin, skull : Huon Peninsula, New Guinea. M 6062 skin, skull : Mandated Territory of New Guinea. M 4326, M 5418, M 5420 skin, skull ; M 9146 skull, skeleton ; S 2140 skull only : New Guinea. M 6751 skin, skull : Taronga Park Zoo, Sydney. M 7999, M 7869, M 19579 skin, skull ; M 24057 skull : Locality unspecified.

Dendrolagus mbaiso M 30719 skeleton, skin ; M 30754 skull, part skeleton : Near summit of Gunung Ki, Tembagapura area, Irian Jaya. M 30751 skull, skin : Southern slopes of Gunung Ki, above Ridge Camp, Tembagapura area, Irian Jaya. M 30749 skeleton, skin ; M 22359 part of skin ; M 22360 left lower jaw : Kwiyawagi area, Irian Jaya.

Dendrolagus scottae M 19481 skin, skull ; M 24427 skin, skull, foot bone : M 25396, M 25397 skull, skeleton ; M 25381 skull ; M 25380, M 25383, M 25384, M 25382 part of skull : Sweipini area, Torricelli Mtns, Sandaun (West Sepik) Province, PNG. M 20948 part of skin : Mt Somoro area, Torricelli Mtns, Sandaun (West Sepik) Province, PNG. M 24424 skin, skull, skeleton : Headwaters of Nengo River, Torricelli Mtns, Sandaun (West Sepik) Province, PNG. M 19491 mandible, skull fragment : Wigote Village, Torricelli Mtns, Sandaun (West Sepik) Province, PNG.

Dendrolagus sp. *cf. D. scottae* M 23044 spirit ; M 21867, M 22257 skin, skull : Northern slope of Mt Menawa near summit, Kitpu, Sandaun (West Sepik) Province, PNG.

Dendrolagus spadix M 4561 skin : Between Strickland and Awarra Rivers, New Guinea. M 5978 skin, skull : Baum River District, Western Division, New Guinea. M 10789 tanned skin, skull : New Guinea. M 15720 skin, skull ; M 15721 skull : Mt Sisa, Southern Highlands Province, PNG. M 17212 skin, skull : Fogamaiyu, Southern Highlands Province, PNG.

Dendrolagus ursinus M 17230 skull only ; M 17882 skin only ; M 28159 half skull, skeletal elements ; M 28262 skin, part skeleton, skull : Arfak Mtns, Irian Jaya.

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